Prepared for:

MANITOBA EDUCATION, TRAINING AND YOUTH

Input into Mathematics *– Final Report –*

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- INTRODUCTION -

A. *BACKGROUND*

Manitoba Education, Training and Youth is a partner in The Common Curriculum Framework for Mathematics, Kindergarten to Grade 12, developed by the Western Canadian provinces and territories under the Western Canadian Protocol (WCP). In the 1995-1996 school year, schools began to implement new curricula for Mathematics based on the student learning outcomes as defined in the WCP Common Curriculum Framework.

WCP jurisdictions have agreed to regularly review the learning outcomes. Therefore, Manitoba Education, Training and Youth decided to survey teachers of Mathematics, as well as school administrators, regarding the Mathematics curriculum for Grades 7 to Senior 2. Proactive Information Services Inc., a Manitoba-based social research company specializing in education, was contracted to assist with the study.

B. *FOCUS FOR THE STUDY*

The underlying purpose was to determine the adjustments, if any, that were required to the Mathematics curriculum and the WCP framework. The survey was designed to focus on the appropriateness of the curriculum for various types of learners, pedagogical approaches, and factors affecting the implementation of the curriculum. Respondents were invited to suggest ways Manitoba Education, Training and Youth could assist them with implementation, as well as any additional comments they would like to make regarding the Mathematics curriculum.

- METHODOLOGY -

A. QUESTIONNAIRE DEVELOPMENT

The questionnaire was developed by Proactive Information Services Inc. in collaboration with staff from Manitoba Education, Training and Youth. The questionnaire was designed to be completed by both teachers and principals.

The questionnaire was primarily "close-ended" questions (i.e. shade ● the appropriate response category). However, there were opportunities to write in extended responses to some questions, including a final "open-ended" question asking for general comments or suggestions. (See Appendix A for a copy of the questionnaire and results by location.)

The questionnaire was printed in both French and English.

B. SURVEY ADMINISTRATION AND RESPONSE

The survey was packaged and distributed by Manitoba Education, Training and Youth to all schools in the province having any or all of Grades 7 to Senior 2. Manitoba Education, Training and Youth staff estimated how many questionnaires to be sent to each school so that there were sufficient numbers for all Mathematics teachers and the principal. In order to encourage response and reduce any financial burden on schools, the packages contained a pre-paid Canada Post courier envelope for return to Manitoba Education, Training and Youth.

The questionnaires were mailed in early October 2000. Reminders were sent to all schools a few weeks later.

Responses were received from 482 schools in 46 school divisions, as well as from a number of remote and special revenue school districts, band operated schools, independent schools, and an institutional school. (See Appendix B for a list of responding jurisdictions.)

A total of 1472 questionnaires were returned; 315 from respondents identifying themselves as administrators (22%) and 1141 from those identifying themselves as teachers (78%). Table 1 shows responses by geographic area, including the Division scolaire franco-manitobaine (DSFM).

Table 1
Respondents by Location

Location	Percent	Number*
Urban	41%	598
Rural	48%	701
North	8%	123
DSFM	3%	49
Total	**100%**	**1471**

* One response was not identifiable by location.

For the purposes of this report, the following geographic definitions were utilizec:

- **Urban Schools** are in School Divisions 1 to 6, 9 to 12, Independent Funded Schools, and Institutional Schools;
- **Rural Schools** are in School Divisions 13 to 44, 47, 50, Band Operated Schools, Individual Band Operated Schools, and Special Revenue Schools Districts;
- **Northern Schools** are in School Divisions 45, 46, 48, and Remote School Divisions.

C. *DATA ANALYSIS AND REPORTING*

Completed questionnaires were forwarded to Proactive for coding of open-ended ("write-in") questions, scanning, and data analysis. Proactive was also commissioned to compile this highlights report. It should be noted that the report provides an overview of significant findings, rather than a detailed discussion of the data.

- HIGHLIGHTS -

A. *RESPONDENT INFORMATION*

1. Respondent Teaching Situation

Respondents were asked to identify at which grade levels they taught Mathematics. Table 2 shows the numbers teaching at each grade level. (Note respondents could teach at multiple levels.)

Table 2
Number of Respondents Teaching by Grade Level

Level Taught	Number*
Grade 7	255
Grade 8	251
Senior 1 (10F)	173
Senior 1 – Transitional	88
Senior 2 – Applied	112
Senior 2 - Consumer	124
Senior 2 - Pre-Calculus	119

* A number of respondents did not indicate these levels.

Not surprisingly, because of the number of respondents who taught Grades 7 and 8, respondents most often indicated (70%) that they taught in a full year timetable. Another quarter (27%) taught in a semester system.Regarding the number of minutes timetabled per day, the number increases with the use of a semester system at the senior years (Table 3).

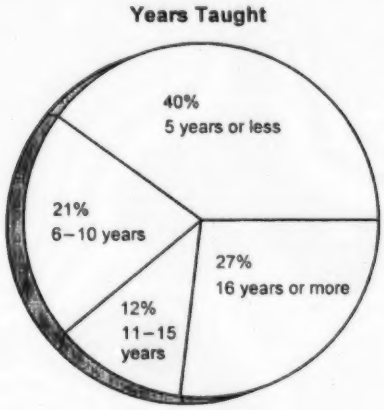
Table 3
Minutes by Grade and Timetable Type*

Grade	Full Year	Semester*
Grade 7	**n = 188**	**n = 46**
▸ 50 minutes or fewer	**48%**	39%
▸ 51-70 minutes	39%	**41%**
▸ 71-90 minutes	6%	15%
▸ 91+ minutes	7%	4%
Grade 8	**n = 180**	**n = 46**
▸ 50 minutes or fewer	**49%**	39%
▸ 51-70 minutes	37%	**41%**
▸ 71-90 minutes	6%	15%
▸ 91+ minutes	8%	4%
Senior 1 (10F)	**n = 85**	**n = 75**
▸ 50 minutes or fewer	**61%**	8%
▸ 51-70 minutes	20%	35%
▸ 71-90 minutes	11%	**52%**
▸ 91+ minutes	8%	5%
Senior 1 – Transitional	**n = 33**	**n = 42**
▸ 50 minutes or fewer	**73%**	19%
▸ 51-70 minutes	3%	33%
▸ 71-90 minutes	15%	**45%**
▸ 91+ minutes	9%	2%
Senior 2 – Applied	**n = 34**	**n = 66**
▸ 50 minutes or fewer	**68%**	5%
▸ 51-70 minutes	9%	44%
▸ 71-90 minutes	21%	**50%**
▸ 91+ minutes	3%	2%
Senior 2 – Consumer	**n = 37**	**n = 72**
▸ 50 minutes or fewer	**68%**	4%
▸ 51-70 minutes	5%	43%
▸ 71-90 minutes	24%	**51%**
▸ 91+ minutes	3%	1%
Senior 2 - Pre-Calculus	**n = 40**	**n = 65**
▸ 50 minutes or fewer	**63%**	3%
▸ 51-70 minutes	8%	**48%**
▸ 71-90 minutes	28%	**48%**
▸ 91+ minutes	3%	2%

* A few respondents indicated teaching in other systems, such as the quarter system. Numbers were very small; therefore, they are not included in this table.

2. Respondent Professional Background

Of the respondents who teach Mathematics, 40% had taught for five years or less. Eight percent were first year teachers. On the other end of the continuum, 27% had taught for 16 years or more (Graph 1).



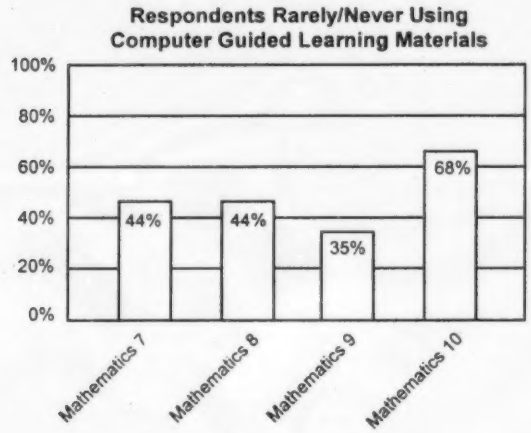
While 81% of respondents had participated in workshops or in-services relating to Mathematics, less than 60% had taken Mathematics methodology from a teacher training institution (57%).

B. *CLASSROOM PRACTICE*

1. Learning Materials and Manipulatives

Respondents were asked to indicate how often they used **computer guided learning materials** in their teaching of Mathematics. The Learning Equation (TLE) was most likely to be used at Grades 7 and 8. At Grade 7, 25% of respondents used TLE a few times a week or more, as did 27% of respondents at Grade 8. TLE 9 and 10 were less likely to be used with this frequency (18% and 8% using a few times a week or more, respectively).

Teachers who used the material rarely or never ranged from 44% at TLE 7 and 8 to 68% at TLE 10 (Graph 2).



Respondents were also asked how often they used various types of manipulative materials with their students. Overall, frequent use of manipulatives was not common practice (Table 4).

Table 4
Infrequent Use of Manipulatives - A Few Times a Year or Less

Type of Manipulative	Rarely/ Never	A Few Times a Year	Total
Algebra tiles	29%	50%	**79%**
Base 10 blocks	51%	32%	**83%**
Bingo chips	45%	39%	**84%**
Cuisinaire rods	66%	26%	**92%**
Fraction blocks/sets	46%	37%	**83%**
Geo Boards	57%	33%	**90%**
Geometric shapes	25%	52%	**77%**
Interlocking/linking cubes	34%	43%	**77%**
Measuring tools (calipers, micrometers, gauges)	35%	41%	**76%**
Pattern blocks	47%	36%	**83%**

2. Assessment Techniques

Respondents were requested to indicate the emphasis they placed on various assessment techniques and strategies in the teaching of Mathematics. Respondents most often indicated that they placed moderate emphasis on "pen and paper tests/quizzes" (93%). (See Table 5.) They most frequently placed little/no emphasis on "conferences/structured interviews" (52%).

Table 5
Assessment Techniques Given Moderate Emphasis

Techniques	%
Pen and paper tests/quizzes	93%
Performance assessment	69%
Investigations/projects	41%
Observation of students using checklists	31%
Student portfolios	27%
Journal learning/log writing	25%
Self/peer assessment	24%
Conferences/structured interviews	14%

C. *CURRICULUM APPROPRIATENESS*

1. Grades 7 and 8

In total, 645 respondents indicated teaching Grade 7 and/or Grade 8 Mathematics. Regarding Grade 7 Mathematics, over three-quarters to over 90% of teachers felt that all outcome areas were "generally appropriate" (Table 6). The same results were evident for Grade 8.

Table 6
Grade 7 & 8 Outcomes - "Generally Appropriate"

Outcome Areas	Gr. 7	Gr. 8
Patterns and Relations		
▸ Patterns	90%	92%
▸ Variable and Equations	84%	87%
Statistics and Probability		
▸ Data Analysis	86%	84%
▸ Chance and Uncertainty	84%	84%
Shape and Space		
▸ Measurement	93%	91%
▸ 3D Objects and 2D Shapes	84%	80%
▸ Transformations	78%	79%
Number		
▸ Number Concepts	90%	90%
▸ Number Operations	90%	90%

Little variation was noted according to geographic area of the province. (See Appendix A for analysis by area.)

2. Senior 1

In total, 361 respondents taught Senior 1 Mathematics (10F). In the case of this curriculum, teachers were asked its appropriateness in terms of high achievers, average achievers, and struggling achievers. Teachers were least likely to believe that the curriculum outcomes were appropriate for struggling achievers (Table 7).

Table 7
Senior 1 (10F) Outcomes - "Generally Appropriate" by Type of Student

Outcome Areas	High	Average	Struggling
Mathematical Reasoning	88%	76%	14%
Statistics	77%	83%	41%
Polynomials	87%	75%	14%
Spatial Geometry	80%	83%	48%
Linear Relations	85%	74%	14%
Similarity and Congruence	85%	77%	21%
Probability	78%	83%	37%
Powers and Exponents	88%	70%	15%
Trigonometry	88%	79%	18%
Measurement	79%	83%	38%
Transformational Geometry	83%	73%	27%

The areas of greatest difficulty ("generally too difficult") for struggling achievers were: mathematical reasoning (84%); polynomials (84%); linear relations (83%); similarity and congruence (78%); powers and exponents (84%); and, trigonometry (80%). Conversely, a number of outcomes were perceived as being "too easy" for 20% or more of high achievers: statistics; probability; and, measurement.

2. Senior 2

In total 191 respondents taught **Senior 2 Applied Mathematics**. Overall, they viewed the outcomes as "generally appropriate" for students (Table 8).

Table 8
Senior 2 Applied Mathematics Outcomes - "Generally Appropriate"

Outcome Areas	%
Spreadsheets	87%
Exploring Mathematics using Technology	91%
Technical Communication	85%
Linear Models and Patterns	86%
2D/3D Projects	87%
Relations and Functions	84%
Coordinate Geometry	95%
Measurement Technology	90%
Trigonometry	90%
Data Management and Analysis	88%

In total, 184 respondents taught **Senior 2 Consumer Mathematics**. In comparison to the Senior 2 Applied Mathematics, there were a number of outcomes not viewed as being "generally appropriate" (Table 9 in bold). In all instances it was because the areas were viewed by approximately 25% to 40% of teachers as too difficult.

Table 9
Senior 2 Consumer Mathematics Outcomes - "Generally Appropriate"

Outcome Areas	%
Problem Analysis	**60%**
Analysis of Games and Numbers	**68%**
Wages and Salaries	93%
Spreadsheets	87%
Trigonometry	**68%**
Spatial Geometry	81%
Consumer Decisions	91%
Geometry Project	**72%**
Personal Banking	95%
Probability and Sampling	80%

In total, 214 respondents taught **Senior 2 Pre-Calculus Mathematics**. At least 88% of respondents believed all outcomes to be "generally appropriate" (Table 10).

Table 10
Senior 2 Pre-Calculus Mathematics Outcomes - "Generally Appropriate"

Outcome Areas	%
Polynomials and Factoring	97%
Analytical Geometry	95%
Trigonometry	98%
Exponents and Radicals	88%
Geometry	93%
Rational Expressions and Equations	90%
Functions	92%
Statistics and Probability	88%
Variation and Sequence	93%

D. *FACTORS AFFECTING IMPLEMENTATION*

1. Factors Assisting Implementation

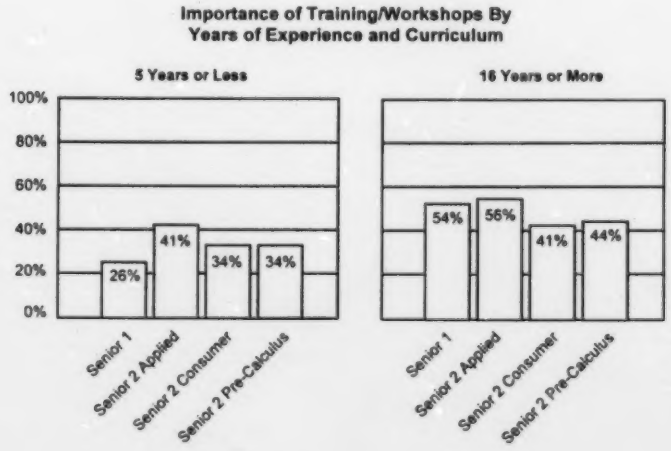
At all levels, with the exception of Senior 2 Applied Mathematics, teachers were most likely to see their own personal time and effort as the factor most likely to assist with Mathematics curriculum implementation (Table 11). Teachers of Senior 2 Applied Mathematics were most likely to see access to technology as the most helpful factor.

Table 11
Top 5 Factors Assisting Implementation by Grade Level

Factors	Grade 7	Grade 8	Senior1 (10F)	Senior 2 Applied	Senior 2 Consumer	Senior 2 Pre-Calculus
Personal time and effort	**71%**	**71%**	**65%**	52%	**57%**	**70%**
Collaborating with fellow Math teachers	60%	53%	56%	49%	50%	61%
Access to training/workshops	54%	53%	41%	52%	40%	37%
Access to learning resources	44%	41%	40%	28%	37%	48%
Access to technology	28%	31%	28%	**59%**		
Support from Manitoba Education and Training					28%	42%

Teachers of Senior 2 Pre-Calculus were most likely to identify Manitoba Education and Training as a support to curriculum implementation. Parental support, student enthusiasm, and support from the school administrator were not identified in the top five factors.

Teachers with more years of experience at the Senior Years level were more likely than their less experienced colleagues to identify the importance of training/workshops (Graph 3).



2. Factors Hindering Implementation

At Grade 7, Grade 8, and Senior 2 Pre-Calculus, teachers most frequently identified students' insufficient mastery of the previous years' work as a factor hindering implementation (Table 12). Teachers of Senior 2 Consumer and Applied Mathematics were most likely to see student attitude/work habits as the factor hindering implementation. There were a number of other differences across the curricula, with the difficulty of outcomes identified at Senior 1 and a lack of access to technology at Senior 2 Applied Mathematics.

Table 12
Top 5 Factors Hindering Implementation by Grade Level

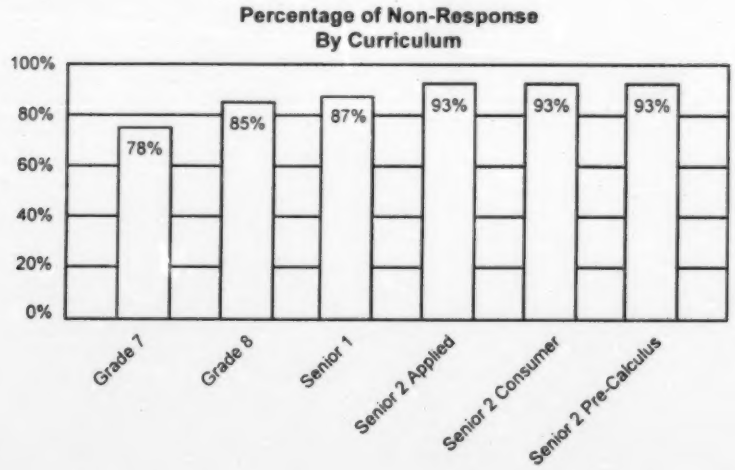
Factors	Grade 7	Grade 8	Senior1 (10F)	Senior 2 Applied	Senior 2 Consumer	Senior 2 Pre-Calculus
Insufficient mastery of previous years' work	**63%**	**60%**	**59%**	43%	45%	**56%**
Curriculum is too long	45%	39%	54%	21%		39%
Student attitude/work habits	44%	48%	55%	**52%**	**73%**	50%
Inadequate class time	36%	34%	24%			31%
Not enough opportunities for collaboration	20%	20%		21%	21%	15%
Outcomes are too difficult for this grade			29%			
Not enough access to technology				31%	18%	
Not enough access to learning resources					17%	

Lack of parental understanding and insufficient professional development were not cited in the top five factors hindering implementation at any level.

No consistent differences were seen according to teachers' years of experience in the factors identified as hindering curriculum implementation.

2. Suggestions for Manitoba Education and Training

The vast majority of respondents did not have suggestions for Manitoba Education and Training regarding how to support teachers with curriculum implementation (Graph 4).



The most frequent suggestion for each curriculum is as follows:

- Grade 7 - more training/in-services/workshops (n = 113);
- Grade 8 - more training/in-services/workshops (n = 88);
- Senior 1(10F) - alternative courses for struggling students (n = 44);
- Senior 2 Applied - more training/in-services/workshops (n = 34);
- Senior 2 Consumer - more access to materials/resources (n = 39); and,
- Senior 2 Pre-Calculus - increase/improve technology and equipment resources (n = 28).

In terms of final comments, the five most frequent were:

- set minimum requirements for each grade level (n = 51);
- need more time to implement the curriculum or shorten curriculum (n = 50);
- need more technology resources/calculators to be available to students (n = 48);
- need an alternative course at Senior 1 (n = 36); and,
- need more professional development opportunities/in-services (n=29).

E. *In Summary*

The following is a brief summary of findings in key areas of this review.

Classroom Practice:

- significant proportion of respondents, ranging from 35% at Senior 1 to 68% at Senior 2 "rarely/never" used the computer guided learning materials, The Learning Equation.
- Use of manipulatives was also infrequent.
- Pen and paper tests/quizzes remained the most frequent assessment practice (93% of respondents), followed by performance assessment (69%). Very few teachers (14%) used conferences/structured interviews.

Curriculum Appropriateness:

- Curriculum outcomes are perceived as being "generally appropriate" at Grades 7 and 8.
- At Senior 1 (10F) curriculum outcomes are perceived as "generally appropriate" for high and average achievers. However, most outcomes are not perceived as appropriate for struggling achievers. This concern was echoed in the final comments on the questionnaire.

- Outcomes for Senior 2 Applied Mathematics were seen as being "generally appropriate."

- While the majority of outcomes for Senior 2 Consumer Mathematics were viewed as being "generally appropriate," areas such as problem analysis, analysis of games and numbers, trigonometry, and geometry project were of some concern.

- Outcomes for Senior 2 Pre-Calculus Mathematics were perceived as being "generally appropriate."

Factors Affecting Implementation:

- Teachers most frequently felt that their own personal time and effort had assisted them with Mathematics curriculum implementation, with the exception of those teaching Senior 2 Applied Mathematics who were most likely to credit access to technology.

- Those with more years of teaching experience were more likely than newer teachers to acknowledge the benefits of in-services/workshops.

- The factor most often viewed as hindering implementation was students' insufficient mastery of the previous year's work. However, teachers of Senior 2 Consumer Mathematics and Senior 2 Applied Mathematics most frequently cited student attitude/work habits.

- Most respondents did not have suggestions for Manitoba Education and Training in terms of how the Department could support Mathematics curriculum implementation. However, the most frequent suggestions were for more training/in-services/ workshops at Grade 7, Grade 8, and Senior 2 Applied Mathematics. At Senior 1, respondents most often requested an alternative course for struggling learners. Senior 2 Consumer Mathematics respondents wanted more access to materials and resources, while Senior 2 Pre-Calculus Mathematics respondents requested increased or improved technology and equipment.